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AUTOMATED LEADING VEHICLE DISTANCE MEASUREMENT BASED ON IMAGE PROCESSING THEORY

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ABSTRACT

As of now, several improvements of detecting and measuring the leading vehicle distance have been carried out, unfortunately failed to meet the requirement of intelligent vehicle technologies providing some unsatisfactory results. One of the common and major drawbacks of such methods is inability to detect black color vehicles with precision. As a solution novel approach is presented in this article emphasizing on clustering based segmentation technique. In this method leading vehicle is identified by homogeneously segmenting an image into region of interest, for this purpose it uses an improved k -means clustering algorithm which classify a data set into clusters according to predefined distance measure by computing the similarity between data elements of a group and the dissimilarity between different groups, the vehicles actual position in the image is determined. Finally, the real distance is obtained by the transform from image coordinate to world coordinate with the camera intrinsic parameters. It is proved that the experimental result is similar to the real value and meets the requirement. The effectiveness of the proposed method has been verified using real video sequences.

KEYWORDS: ITS, Frame Extraction, Segmentation by K-means Clustering, Target Identification

INTRODUCTION

The main reason for the interest in efficient advanced vehicle control system is, in past decade, the number of motor vehicles in the developing countries is increasing gradually. Thus it leads to emergence of Advanced Vehicle Control System (AVCS) [1].

AVCS is an important component of the Intelligent Transportation System (ITS). By measuring the leading vehicle distance, it can provide effective vehicle driving information for the prevention of traffic accident, thereby enhancing traffic safety level.

This project outlines the approach to restrain the transportation (or car) accidents caused by dangerous vehicle behaviors, especially those of lane departure and speeding. The possibility of car collision will reduce when this approach is equipped in-vehicle vision-based system that monitors the sight in front of the car and issues certain necessary warning. In the interim, the related image processing technique which can reduce the impact of human action and make the foundation for the further study on Advanced Vehicle Control System (AVCS) is proposed [3]. Finally, the proposed approach is validated through several real life video sequences.

IMAGE PRE-PROCESSING

Image pre-processing can improve image quality and reduce image noise and lay the foundation for obstacle detection. Required to select an appropriate way in digital image processing method to conduct a comprehensive preprocessing to image.

Frame Extraction

Video segmentation is a fundamental process and the first step in automatic digital video analysis. It is of great importance in many applications, such as video databases, video compression and transmission, video retrieval and browsing, and so on.

A video can be segmented into different units, such as frames, shots, or scenes. The structure of a video is shown in Figure 1. The complete moving picture in a video can be discretized to a finite image sequence, i.e., many still images. Each still image is called a "*frame*", which is the basic unit of the video. The image sequence is naturally indexed by the *frame number*. All the frames in one video have a same size and the time between each two frames is equal, typically 1/25 or 1/30 seconds. A video *shot* is defined as a series of interrelated consecutive frames taken contiguously by a single camera and representing a continuous action in time and space [1]. In general, shots are joined together in a process called editing to produce a video. The unbroken image sequence in a shot usually has consistent content. While *scene* is a more semantic notion, which is essentially a story unit

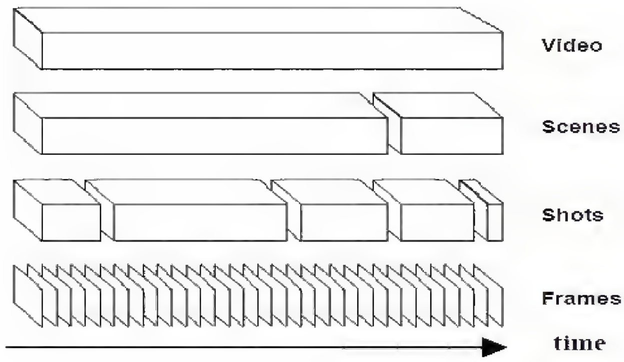

Figure 1: Structural Hierarchy of a Video

There are two image pre-processing techniques such as

Gray Conversion of Image

Numerical images are divided into colorful images and gray images. In the RGB model, if R= G= B, then the color means a kind of gray, the value is called a gray value. The processing of the gray conversion is the process that a color image is transferred into a gray one.

$$f(x, y) = 0.2989 * R(x, y) + 0.5870 * G(x, y) + 0.1140 * B(x, y)$$

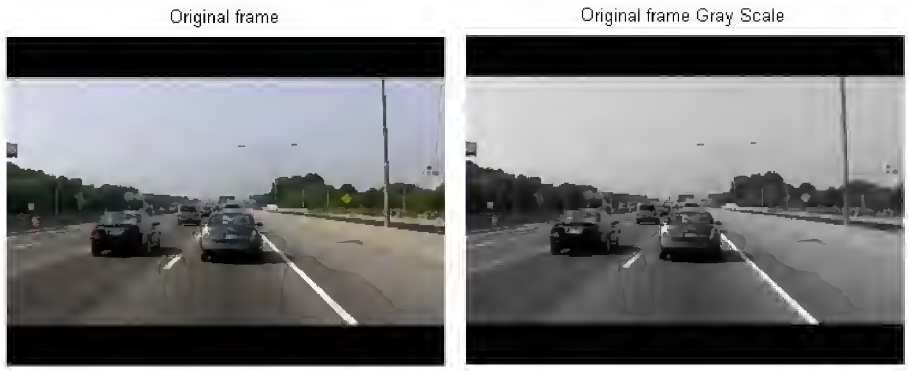

Figure 2

CLUSTERING ALGORITHM

Clustering is the task of assigning set of objects into groups called as clusters so that the objects in one cluster are more similar than the objects in other cluster. Clustering itself is not one specific algorithm but it is task which can be performed by various algorithms that differs from each other in their methods of computing/finding the cluster. Clustering is process of grouping similar image pixels according to some property into one cluster so that the resulting output cluster shows high intra-cluster similarities and low inter-cluster similarities.[11]

K-Means

k-means is commonly used simplest algorithm which employs the square error criterion. In this algorithm the number of partitions is initially defined. The cluster centers are randomly initialized for predefined number of clusters. Each data point is then assigned to one of the nearest cluster. The cluster centers are then re-estimated and new centroid is calculated. This process is repeated until the convergence has been reached or until no significant change occurs in cluster center[8]

μ_i i = 1: : : k which are obtained by minimizing the objective

$$V = \sum_{i=1}^{k} \sum_{x_j \in S_i} (x_j - \mu_i)^2$$

where there are k clusters S_i, i = 1, 2….. k and μi is the centroid or mean point of all the points $x_j \in S_i$ As the main portion of this project, in order to solve the problem the algorithm was implemented. The algorithm takes a 2 dimensional image as input:

- Compute the intensity distribution of the intensities
- Initialize the centroids seeds with k random intensities
- Repeat the following steps until the cluster labels of the image does not change Anymore
- Regroup the seeds based on distance of their intensities from the centroid intensities

$$c^{(i)} := \arg\min_j ||x^{(i)} - \mu_j||^2$$

- Assign the new centroid for each of the clusters formation

$$\mu_i := \frac{\sum_{i=1}^{m} 1\{c_{(i)} = j\} x^{(i)}}{\sum_{i=1}^{m} 1\{c_{(i)} = j\}}$$

Where k is a parameter of the algorithm (the number of clusters to be found), i iterates over the all the intensities, j iterates over all the centroids and μi are the centroid intensities. [24][25]

OBSTACLE DETECTION IN PRACTICE

The key parameter in clustering process is the selection of the threshold value. There are number of different methods available for choosing threshold.

The mean or median can be used as threshold for the noiseless image with uniform background, but it is not always possible.

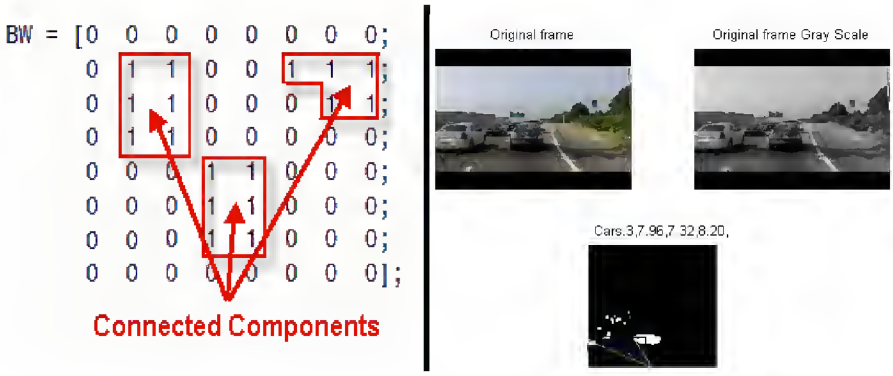

Figure 3

CONCLUSIONS

The result consist different frames of video sequences, Clustering provide simple and effective approach to solve the problem of detecting black cars Minimum distance measure is improving relevancy of retrieval images.

The system for detecting obstacles using a monocular camera is described. The system can access information about the vehicle's state, like speed. Using this information it is possible to detect motion or stationary scenarios and adapt the system behaviour.

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